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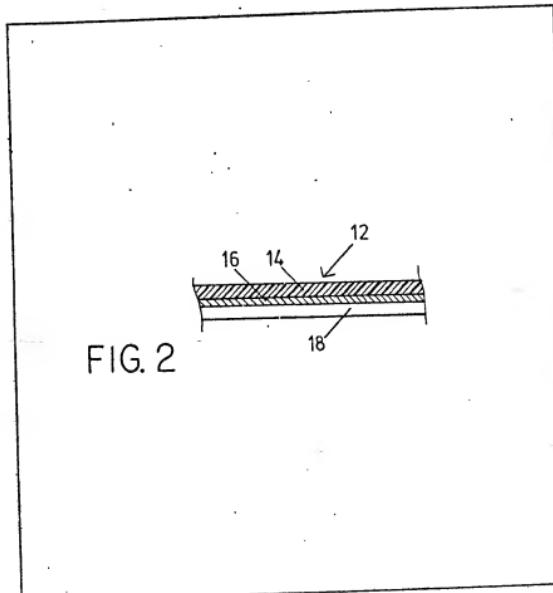
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(54) Food receptacle for microwave
cooking

(57) A disposable food receptacle for
use in microwave cooking includes
provision to brown the exterior of the
food in the receptacle by use of a thin
layer 16 of an electrically conductive
material, such as an elemental metal
incorporated into the receptacle, so

that the conductive layer will become
heated by the microwave radiation and
will, in turn, brown the exterior of the
food in the receptacle. The conductive
layer 16 is formed as an extremely
thin film deposited on a substrate
protective layer 14 by a process of
vacuum vapor deposition. A base layer
18 is provided behind the conductive
layer 16.



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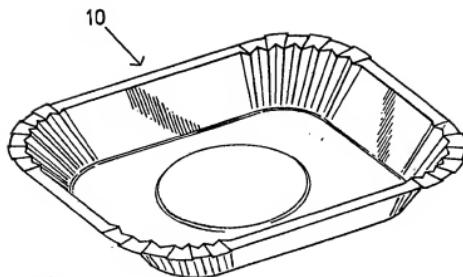


FIG. 1

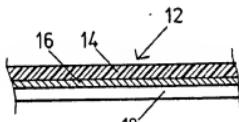


FIG. 2

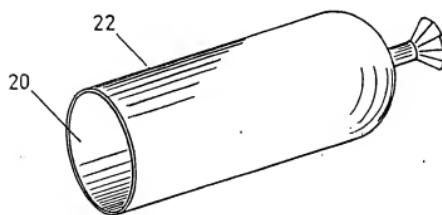


FIG. 3

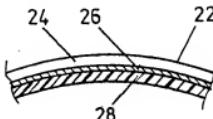


FIG. 4

SPECIFICATION**Food receptacle for microwave cooking.****BACKGROUND OF THE INVENTION****FIELD OF THE INVENTION**

5 The present invention relates to food packages in general, and in particular, to food receptacles for use in the microwave cooking of foods which incorporates therein provisions for the browning of the exterior of the food in the receptacle.

10 DESCRIPTION OF THE PRIOR ART

It is of general concern in the art of microwave cooking that the exterior of the food being cooked is browned so as to more closely resemble food cooked by conventional methods. If a special provision is not made for browning the exterior of the food, the exterior of the food cooked in a microwave oven will remain undercooked because of the surface cooling effect of the food as it is heated by microwave radiation. Therefore it has been a general object within the art of microwave cooking of foods to perfect an economical and efficient method for browning the exterior of the foods being cooked in a microwave oven.

The prior art is generally cognizant, therefore, of various attempts to incorporate layers into receptacles used for the microwave cooking of foods, which layers are designed to be particularly susceptible to being heated by microwave radiation. Such layers are conveniently made of semi-conductive materials such as tin oxide. Examples of U.S. patents showing the use of such layers can be seen in U.S. Patents No. 3,853,612 and No. 3,965,323. Other examples of methods used to obtain browning heat from microwave radiation are shown in U.S. Patents No. 2,582,174, No. 3,701,872, No. 3,773,669, and No. 4,003,840.

In addition at least one example is known of a method of heating foods in a microwave oven which incorporates therein the use of ferromagnetic metals. Such example is shown in U.S. Patent No. 2,830,162. In addition at least one U.S. patent teaches the incorporation of an electrically conductive film in a ceramic dish or other heavy vessel for use in the browning of foods cooked in a microwave oven. However, the examples shown in that patent, which is U.S. Patent No. 3,783,220, are directed to a film of tin oxide, with alternative substances disclosed being cellulose fiber and silicon carbide. No example of such a container for use in the browning of foods in a microwave oven is known in the prior art which incorporates therein the use of an elemental metal, nor the use of an extremely thin conductive film on a low cost, disposable substrate.

SUMMARY OF THE INVENTION

The present invention is summarized in that in a food preparation receptacle for use in microwave cooking of foods there is an improvement 60 including a layer of electrically conductive

thin so as to be rapidly heated upon exposure to microwave radiation and cause surface browning of the food in the receptacle.

65 It is a primary object of the present invention to provide a means for the browning of foods cooked in a microwave oven which can be incorporated into disposable packages or receptacles for pre-packed or frozen food.

70 It is another object of the present invention to construct a suitable food packaging which incorporates therein such a provision for browning the exterior of the food to be cooked in a microwave oven.

75 It is yet another object of the present invention to incorporate a provision for such browning of foods during microwave cooking which is economical and efficient in its operation.

80 Other objects, advantages, and features of the present invention will become apparent from the following specification when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

85 Fig. 1 is a perspective view of a food package constructed in accordance with the present invention.

Fig. 2 is an enlarged cross-sectional view of the material of the package of Fig. 1.

90 Fig. 3 is a perspective view of an alternative embodiment of a food package constructed in accordance with the present invention.

Fig. 4 is an enlarged cross-sectional view of the material of the package of Fig. 3.

95 DESCRIPTION OF THE PREFERRED EMBODIMENT

Shown in Fig. 1 is a food receptacle for use in microwave cooking, generally indicated at 10, constructed in accordance with the present invention. The receptacle 10, as shown in Fig. 1, is

100 a four-sided generally tray shaped package for receiving a prepared quantity of food material therein. The receptacle 10 as shown includes shallow sides and a wide bottom and may or may not include a top covering thereover, or may be constructed in any desired geometry or shape depending on the contents to be carried by the receptacle 10. The receptacle 10 is designed especially so as to be disposable, and is therefore constructed of economical commercially available components.

110 Shown in Fig. 2 is a cross-sectional diagram of the package material from which the package 10 of Fig. 1 is constructed. This package material, which is indicated at 12 in Fig. 2, includes 115 generally three layers. The uppermost layer as illustrated in Fig. 2, which is designed to be the layer most near to the food product, is a high heat tolerant protective layer 14. Formed underneath the protective layer 14 is an extremely thin layer of conductive material, such as vacuum vapor deposited electrically conductive elemental metal 16, for example a thin layer of elemental aluminum. The combination of the protective

material 18. The function of each of these layers will be described in turn.

The function of the stock material 18 is to provide structural rigidity and support for the physical shape of the package 10, whatever the configuration of the package 10 may be. The stock material layer 18 is preferably formed of a low density material having a relatively high insulating capacity and a heat stability sufficient to 10 withstand cooking temperatures in a microwave oven. Suitable materials for use as this stock material are papers, glassine materials, plastics, ceramics and various coated papers. Preferred materials for use in disposable receptacles include 15 coated kraft paper and other conventional kraft paper combinations conventionally used for paperboard cartons and packages.

The function of the protective layer 14 is to ensure that the food product inside of the 20 receptacle 10 does not contact the metal layer 16 or the stock material layer 18. The protective layer 14 also serves as a stock material onto which the metal layer 16 may be deposited during the construction of the package material 12. Suitable 25 materials for use in constructing the protective layer 14 include polyesters, polyethylene, nylon, cellulose, polysulphone, and other relatively stable plastic substances. It is important that the material of the protective layer 14 be of sufficient stability at high temperatures that it will not 30 degrade during the operation of the microwave oven at the temperature selected for cooking the desired food. It has been found that polyester is a particularly well suited material for use as the protective layer 14 in view of its stability and its 35 surface smoothness.

Also included within the package material 12 is the metal layer 16 bonded to the rear surface of the protective layer 14 and the food contacting 40 surface of the stock material 18. The metal layer 16 is formed as a vacuum vapor deposited film of electrically conductive elemental metal, which, as stated above, is preferably deposited on the lower surface of the protective layer 14 before such 45 layer is bonded to the stock material 18. It is a primary characteristic of the metal layer 16 that it is extremely thin in terms of its mechanical thickness. In fact, under current technology it is virtually impossible to mechanically measure the 50 exact thickness of the layer of the metal film 16. In the general art of vacuum vapor deposition, it is therefore conventional to measure the thickness of vacuum vapor deposited layers of electrically conductive metal material in terms of the surface 55 resistivity of the metal layer itself. This is possible inasmuch as these deposited metal layers are so thin that they have an appreciable and easily measurable resistance to the flow of electrical current such as is not the case in conventional thickness metal films or foils. Having measured the electrical resistivity of a metal layer, it is possible within reasonable degree of certainty to 60 approximate the mechanical thickness of such a layer based on the amount of metal material

application of the metal layer onto the substrate, which in this case is the protective layer 14. It is to be understood however, that the film of the metal layer 16 is of such a thickness that direct

70 measurement of its dimensions are impossible, and such measurements must be made indirectly. Such films are conventionally so thin that when deposited on transparent materials they may readily be seen through by the human eye.

75 A film of the type of the metal layer 16 in the package of the present invention serves to provide a browning function in a package for food when cooked in a microwave oven. In conventional microwave cooking, it is normally believed that it 80 is bad practice to include utensils or packages incorporating therein any significant amounts of elemental conductive metals. Many microwave oven manufacturers include instructions with their ovens warning against the use of aluminium or

85 similar metal utensils within the microwave oven. Such warnings are included to avoid a reflection problem inasmuch as microwaves are unable to penetrate such metal utensils and are reflected backwardly therefrom. Such reflections can result

90 in areas of food within the oven not being cooked, and can potentially, in some situations, cause damage to the klystron of the microwave oven. It is also readily observable that conventional foil products such as aluminium foil do not heat up 95 when subjected to microwave radiation, thus making such material inoperative as a heat source for surface browning of foods in a microwave oven.

Applicant has found, however, that when a 100 metal layer 16 is of sufficient thinness, it surprisingly does not detract from the operation of the microwave oven and, apparently because of its incomplete reflection of the microwaves incident thereon, is, in fact, heated very efficiently by the

105 microwave oven. Thus, when the receptacle 10 of the present invention with food therein is placed within a microwave oven and subjected to microwave radiation, the metal layer 16 rapidly heats to a relatively high temperature. The heat 110 generated by the metal layer 16 acts to brown the surface of the food contained within the receptacle 10. Such browning effect is a significant advantage in receptacles for food designed to be cooked in microwave ovens.

115 In conducting experimentation upon the use of the metal layer 16 and receptacles for use in cooking foods in a microwave, a variety of different thicknesses of the metal layer 16 have been used with success. It has been generally

120 found that metal layers 16 having a surface resistance which varies between about .4 and 8 ohms per square inch offer satisfactory results in a receptacle according to the present invention. As stated, the thickness of this material is not directly

125 mechanically measurable, but appropriate calculations indicate that a film of aluminum in the metal layer 16 would have a thickness of between 200 and 300 angstroms if its resistance

that for the metal aluminum, thicknesses having a surface resistance of between .4 and 8 ohms per square inch vary in thickness between approximately 700 and 40 angstroms.

5 Such films as the metal layer 16 may be deposited on substrates, in this case the protective layer 14, most efficiently through the use of vacuum vapor deposition. Such technique involves the melting of elemental metal material in a 10 vacuum chamber and drawing the substrate through the vacuum chamber in close proximity to the melted metal material. The molten metal material emits a metallic vapor which is deposited on the substrate as it moves through the chamber, 15 and the amount of material deposited on the substrate may be adjusted by the rate at which the substrate moves through the vacuum chamber. It is believed that such vacuum vapor deposition technique is the most efficient manner for making 20 the metal layer 16 usable within the present Invention. It is an advantage of such materials, that many types of such materials, such as aluminum coated on polyester, usable in the present invention, are readily commercially available at the 25 present time.

The exact upper limit of the metal layer 16 usable in the present invention is not readily determinable using currently commercially available products. For example, the thinnest 30 commercially available film or foil of aluminum material that is pin-hole free has a thickness of approximately .00025 inches. This thickness corresponds to approximately 65,000 angstroms. Experimentation has shown that this thickness is 35 too great to allow this foil to heat up upon exposure to microwaves. The gap between the thinnest commercially available foils, i.e. the .00025 inch foil, and the vacuum vapor deposited films presently marketed is presently about two 40 orders of magnitude, and no materials are readily available on the shelf between these two thicknesses. It is believed by the applicant that metal films for use within the metal layer 16 of the present invention may prove functional at some 45 thickness greater than that described in this application. However the exact limit of mechanical thickness is unknown at present.

In order for a technology to be useful for forming the metal layer 16 of the present 50 invention, the metal layer 16 must be of such thinness as to be readily and rapidly heated upon the exposure thereto by microwave radiation. Such heating of such a metal layer 16 must be rapid, which as used herein is meant to mean that 55 the heating must occur within a sufficient amount of time and reach a sufficient temperature as to be capable of browning the exterior of foods during the normal cooking time of such foods in a microwave oven. As for example, it has been 60 found that a vacuum vapor deposited metal layer 16 having a surface resistance of approximately 2 ohms per square inch is capable of achieving a temperature in excess of 200° within 30 seconds.

square inch will achieve a temperature exceeding 200° in a time period between 20 and 30 seconds. There appears to be a generally linear relation between the surface resistivity of the

70 metal film used for the metal layer 16, and the amount of time required to achieve a certain temperature for that metal layer when exposed to microwave radiation. The more surface resistance of the metal layer, the faster the metal layer 16 75 heats upon exposure to microwave radiation. In any event, it is necessary for such a metal layer 16 which is to be used within the receptacle 10 of the present Invention to achieve and hold a browning temperature, which is generally in excess of 200° 80 F., within a period of time short enough so as to brown the exterior of the food during the time necessary to cook the food received within the receptacle 10.

Shown in Fig. 3 is an alternative embodiment of 85 a food receptacle constructed in accordance with the present invention. The receptacle of Fig. 3, generally indicated at 22, is intended to encase thereto a quantity of sausage 20 or similar sausage type material. The receptacle 22 is 90 formed as a thin wrapping of material about the exterior of the sausage 20. Fig. 4 shows an enlarged view of the package material of the package 22. Similar to the receptacle 10, the receptacle 22 includes a protective layer 28 upon 95 the back of which a vacuum vapor deposited metal layer 26 is arranged. The combination of a protective layer 28 and the metal layer 26 is received inside a stock material 24 which wraps around the exterior of the receptacle 22. The stock 100 material 24 of the receptacle 22 is selected so as to be much more flexible than the stock material 18 of the receptacle 10.

The receptacle 22 of Figs. 3 and 4 functions in much the same way as the receptacle 10 of Figs. 105 1 and 2. Upon exposure to microwave radiation, the receptacle 22 serves to brown the exterior of the sausage 20 received within the receptacle 22. Such exterior browning is extremely helpful in the art of sausage making inasmuch as it sterilizes and 110 seals the exterior of the sausage 20. By using a receptacle 22 constructed in accordance with the present invention, it is possible for such sterilization and sealing to be accomplished in an efficient and economical manner by the exposure 115 of finished sausages 20 encased in the receptacle 22 to microwave radiation at the processing plant.

It is envisioned that many types of receptacles for use within the present invention may be constructed utilizing the metal layer 16 therein. 120 Thus it is envisioned that many disposable-type receptacles for use in the microwave cooking of convenience, frozen, or other pre-packaged foods may be constructed. In addition it is also envisioned that a metal layer 16 may be 125 incorporated into a receptacle such as serving dishes, plates, or casserole dishes which are not, of course, of a disposable nature and are more in the nature of housewares to be readily reused by a homemaker during the preparation of foods in a

receptacle including the metal layer 16 according to the present invention may be any of a wide variety of wrappings which are used to wrap foods, such as is shown in the sausage package 5 22 of Figs. 3 and 4.

It is a particular advantage of the present invention, however, in that it allows the construction of a disposable receptacle which includes a provision for the browning of food in a 10 microwave oven whether the layer 16 is formed of metal or other conductive material. Prior art receptacles for browning microwave cooked foods have been large, massive and relatively expensive articles entirely unsuited for food packaging but 15 usable only as dishes or cooking utensils. By combining readily available and economical materials in the receptacle of the present invention, a food package can be constructed which can be used to package the food for the 20 consumer and for its cooking and browning in a microwave oven, after which the package can be discarded. This result was not possible in the prior art. Furthermore because conductively coated polyester and paperboard materials, which 25 are the preferred materials for such a package, are relatively light and of low density, they make more efficient use of the microwave energy absorbed than would a heavy ceramic or glassine utensil which requires a substantial amount of heating 30 before it becomes hot to the touch. Thus a food package, such as the receptacle 10 of Figs. 1 and 2, constructed in accordance with the present invention offers a significant advance in the art of browning devices for foods cooked in microwave 35 ovens by enabling a disposable device capable of effective and efficient operation.

It is further envisioned that a number of metals other than aluminum may be used for the metal layer 16 when that layer is used in the receptacle 40 according to the present invention. It is believed important, however, that the material for use in the metal layer 16 be an elemental metal and that the metal be of an electrically conductive character. Other suitable metals for use within the 45 metal layer 16 include copper, tin, lead, silver, gold, nickel, and zinc, although some of those obviously would not be chosen for disposable receptacles because of cost considerations. It is also envisioned that combinations or alloys of 50 these metals are also usable in the present invention. While the exact thickness of the metal layer 16 necessary to achieve a browning effect may vary with the metal utilized for the metal layer 16, it is envisioned that any such metals would be 55 most efficiently used in constructing such a layer by vacuum vapor deposition, and that the surface conductivity of the metal layer 16 would be approximately equivalent for the different metal materials when used within a receptacle in 60 accordance with the present invention.

It is to be understood that the present invention is not limited to the particular construction and arrangement of parts disclosed and illustrated

65 thereof as come within the scope of the following claims.

CLAIMS

1. In a food preparation receptacle for use in microwave cooking of foods the improvement 70 comprising:
 - a layer of electrically conductive elemental metal incorporated into the receptacle, the layer of metal being sufficiently thin so as to be rapidly heated upon exposure to microwave radiation and 75 cause surface browning of the food in the receptacle.
 2. In a food preparation receptacle for use in microwave cooking of foods the improvement as claimed in Claim 1 wherein the metal layer has a resistivity greater than about .4 ohms per square inch.
 3. In a food preparation receptacle for use in microwave cooking of foods the improvement as claimed in Claim 1 wherein the layer of metal is aluminium.
 4. A food preparation receptacle for use in microwave cooking of foods comprising:
 - a stock material formed into a suitably shaped structure to carry the desired food;
 - 50 90 a protective layer formed on the food contacting surfaces of the stock material; and a layer of aluminium arranged between the protective layer and the stock material, the aluminium layer having a thickness of less than about 700 angstroms so that the aluminium layer will be heated when exposed to microwave radiation to brown the food in the receptacle.
 5. A food preparation receptacle as claimed in Claim 4 wherein the aluminium layer has a thickness of between about 30 and about 700 angstroms.
 6. A food preparation receptacle as claimed in Claim 4 wherein the protective layer is formed of a thermoplastic resin having high heat stability.
 - 105 7. A food preparation receptacle as claimed in Claim 6 wherein the thermoplastic resin in the protective layer is a polyester.
 8. A food preparation receptacle as claimed in Claim 7 wherein the aluminium layer is deposited on the polyester layer.
 - 110 9. A food preparation receptacle as claimed in Claim 8 wherein the aluminium layer is deposited by vacuum vapor deposition on the polyester layer.
 - 115 10. A food preparation receptacle as claimed in Claim 4 wherein the stock material is paperboard.
 11. A food preparation receptacle for use in microwave cooking of foods comprising:
 - a stock material formed into a suitably shaped structure so as to carry the desired food;
 - 120 a protective layer formed on the food contacting surfaces of the stock material; and a layer of electrically conductive elemental metal arranged between the protective layer and the stock material, the metal layer being of a suitable thickness so as to have an electrical resistivity of at least about .4 ohms per square

microwave radiation to brown the food in the receptacle.

12. A food receptacle as claimed in Claim 11 wherein the metal layer is aluminum.

5 13. A food receptacle as claimed in Claim 11 wherein the resistivity of the metal layer is between about .4 and 8 ohms per square inch.

14. A food receptacle as claimed in Claim 11 wherein the protective layer is a sheet of high 10 temperature stability thermoplastic material.

15. A food receptacle as claimed in Claim 12 wherein the metal layer is deposited on one surface of the thermoplastic film.

16. A food receptacle as claimed in Claim 15 15 wherein the metal is deposited on the thermoplastic film by vacuum vapor deposition.

17. A food receptacle as claimed in Claim 11 wherein the stock material is paperboard.

18. A food preparation receptacle for use in 20 microwave cooking of foods comprising:
a stock material formed in a suitably shaped structure so as to carry the desired food;
a protective layer formed on the food contacting surfaces of the stock material; and

25 a thin layer of electrically conductive elemental metal deposited by vacuum vapor deposition on the protective layer and positioned between the protective layer and the stock material, the metal layer being heated upon exposure to microwave radiation to brown the food in the receptacle.

19. A food preparation receptacle as claimed in 30 Claim 19 wherein the metal is aluminum.

20. A food preparation receptacle for use in microwave cooking of foods comprising:
a stock material formed into a suitably shaped 35

structure so as to carry the desired food;
a protective layer formed on the food contacting surfaces of the stock material; and
a layer of electrically conductive elemental metal arranged between the protective layer and the stock material, the metal layer being of a suitable thickness so as to have such an electrical resistivity that it will be rapidly heated when exposed to microwave radiation to brown the exterior of food in the receptacle during the normal microwave cooking of that food.

21. A disposable food package comprising:
a low density insulating stock material of suitable shape and structure to contain the food;

50 22. A food package as claimed in Claim 21 wherein the stock material is paperboard.

23. A food package as claimed in Claim 21 wherein the layer of conductive material includes a layer of conductive elemental metal.

24. A food package as claimed in Claim 23 55 wherein the elemental metal is aluminum.

25. A food package as claimed in Claim 23 wherein the metal layer is formed by vacuum vapor deposition on the protective layer.

26. A food package as claimed in Claim 21 60 wherein the protective layer is polyester.